

Procedure	Denomination / Instrument Producer	For ¹	Description	Standard
Internal mixer 90l (intermeshing)	GK 90 E	C	Mixing including batch-off finishing	In-house procedure
Internal mixer 5l (intermeshing)	GK 5 E	C	Mixing	
Internal mixer 1.5l (tangential)	Farrel	C	Mixing	
Internal mixer 2.0l (tangential)	Bauknecht	C	Mixing	
Internal mixer 1.5l (intermeshing)	GK 1.5 E	C	Mixing	
Internal mixer 1.6l (tangential)	COPE	C	Mixing	
Internal mixer 350 ml	Brabender	C	Mixing	
Internal mixer 85 ml	Brabender	C	Mixing	
Internal mixer 100ml	Haake Rheomix OS	C	Mixing	
Internal mixer 600 ml	Brabender	C	Mixing	
Pressmixer 1.4l	HPM 10/GI	C	Mixing of low viscosity compounds	
Microcompounder 15ml	DSM	C	Twin screw mixing and sample preparation	
Mill	Variuos sizes	C	Mixing	
Mill shrinkage		C	Mixing	
Vulcanization	Steam-and electrically heated	C	Curing of slabs and samples	
UV crosslinking	UVA-Cube 2000	C		

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Procedure	Denomination / Instrument Producer	For ¹	Description	Standard
90 mm vacuum extruder	Berstorff L/D = 20	C	Continuous extrusion of hoses and profiles (incl.vulcanization in microwave channel or liquid salt bath)	In-house procedure
45mm extruder		C		
Gel Test (KEL method)		C		
19mm extruder		C		
Twin screw extruder	ZSE 27-48 MAXX	C	Twin screw compounding	
Extrusion test (various dies, e.g. Garvey)	19mm Brabender L/D = 10	C	Processability of rubber compounds	
Extrusion test (various dies)	45mm Troester Measuring Extruder L/D = 10	C	Processability of rubber compounds	
Injection molding test	DESMA	C	Characterization of mold fouling and injection faults	

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Procedure	Denomination / Instrument Producer	For ¹	Description	Standard
Aging in Chemicals		V	Aging/swelling open vessel	In-house procedure
Aging in Chemicals		V	Aging/swelling pressure vessel / elevated temperature	
Aging in Steam		V	Steam aging	
Aging in Hot air		V	Hot air aging	
Post-cure		V		

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Procedure	Denomination / Instrument Producer	For ¹	Description	Standard
Stress relaxation in compression	Elastocon	✓	Decay of stress under constant compression	In-house procedure
Compression set	LANXESS	✓	Remaining deformation after a period of compression	DIN ISO 815 VW-3307 DBL-5555 ASTM D 395
Shore hardness	Barreis	✓	Resistance against indentation of a defined cone	DIN 53505 ASTM D 2240
Hardness (IRHD)	Zwick	✓	Resistance against indentation of a ball with a specific force	DIN 53519-1
Microhardness (μ -IRHD)	Zwick	✓	Resistance against indentation of a ball with a specific force	DIN 53519-2
Crystallization	Barreis	P,C,V	Change of hardness with time (Shore A) by crystallization	DIN 53541
TR test (temperature retraction)	Gibitre	✓	Recontraction of strained elastomer samples with temperature	ISO 2921
Stress relaxation in tension				
Adhesion to fabric (room and other temperature)	Zwick	✓	Adhesion between fabric and elastomer layers	DIN 53530
Cord adhesion test	-	✓	Separation force between cord and rubber	ASTM D 2229 In-house procedure
Tear test	Zwick, (Instron)	✓	Resistance of various sample shapes against tear	DIN ISO 34 ASTM D 624
Tension set	Zwick,Instron	✓	Remaining deformation after storage under constant elongation	DIN ISO 2285

Procedure	Denomination / Instrument Producer	For ¹	Description	Standard
Tensile test, ring Tensile test, ring, elevated temperature Tensile test,dumbbell Tensile test,dumbbell,elevated temperature	Zwick,Instron	V	Stress-strain behavoir,ultimate elongation and maximum stress under elongation	DIN 53504 ISO 37 ASTM D 412
Greenstrength Tensile test,Dumbbell	Zwick,Instron	P,C	Stress-strain behavoir,ultimate elongation and maximum stress under elongation	DIN 53504 ASTM D 6746
Peel strength	Zwick,Instron	V		
Adhesive shear strength	Zwick,Instron	V		
Tel-Tak Tester	Monsanto			In-house procedure
Rebound resilience	Zwick	V	Relative rebound height of a pendulum	DIN 53512
Brittleness point	Gibitre	V	Estimation of the brittleness temperature	DIN 53546, ASTM D 746 ASTM D 2137 DIN ISO 812
Abrasion	Zwick, (Maqtest)	V	Resistance against wear on a rotating drum	DIN ISO 4649 ASTM D 5963
Abrasion	Taber	V	Resistance against wear due to rubbing abrasion	ASTM 3389
Akron abrasion	-	V	Resistance to abrasive wear	In-house procedure
Skid resistance	BPSR tester	V	Coefficient of friction between rubber and other surfaces	In-house procedure
Goodrich flexometer	BF Goodrich	V	Heat built up,fatigue life and creep under sinusoidal compressive load	DIN 53533
De Mattia fatigue life	Zwick, Maqtest	V	Fatigue under cyclic bending defomation	DIN 53522

Procedure	Denomination / Instrument Producer	For ¹	Description	Standard
Ross Flex fatigue life	Emerson	V	Fatigue under cyclic bending defomation	ASTM D 1052
Tear analyser	Coesfeld	V	Crack propagation rate under pulsed or sinusoida elongation	In-house procedure

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Procedure	Denomination / Instrument Producer	For ¹	Description	Standard
Standard Tests				
Mooney(viscosity)	Alpha Technologies	P,C	Viscosity of uncured materials	DIN 53523 ISO 289 ASTM D 1646
Mooney (scorch)	Alpha Technologies	P,C	Scorch behavior of unvulcanized compounds	DIN 53523
Rheovulcameter	Göttfert	C	Simulation of injection molding	In-house procedure
Curemeter (MDR) 30 min.	Alpha Technologies	P,C	Curing behavior	ASTM D 5289
UV Curemeter	MCR - UV system	P,C	Curing behavior due to UV source	In-house procedure
Temperature-dependent modulus and phase angle				
-100°C to 150°C	Mettler DMA/SDTA 861e	V	Temperature-dependent viscoelastic properties (f , γ = const., sinusoidal mode)	Similar to DIN ISO 6721
-100°C to 150°C	ARES	V	other T-ranges on request	
-100°C to 150°C	GABO Eplexor	V		
Gehman	Elastocon	V	Low temperature stiffening using a torsional wire apparatus	ISO 1432 ASTM D 1053
Frequency-dependent modulus and phase angle				
0,01 Hz to 40 Hz	SIS-V50, Alpha	P,C		In-house procedure
0,1 Hz to 100 Hz	Mettler DMA/SDTA 861e	P,C,V	Frequency-dependent viscoelastic properties (T , γ = const., sinusoidal mode) other f-ranges on request	In-house procedure
0,1 Hz to 100 Hz	GABO, Metravib	V	Frequency-dependent viscoelastic properties (T , γ = const., sinusoidal mode) other f-ranges on request	In-house procedure

Procedure	Denomination / Instrument Producer	For ¹	Description	Standard
0,1 Hz to 100 Hz	Paar-Physica MCR 300	P,C,V	Frequency-dependent viscoelastic properties (T, γ = const., sinusoidal mode) other f-ranges on request	In-house procedure
0,1 Hz to 200 Hz	MTS 831 Elastomer test system Metravib	V	Frequency-dependent viscoelastic properties (T, γ = const., sinusoidal mode) other load modes on request	In-house procedure
Master curve construction	-	P,C	Combination of temperature and time-dependent measurements and application of the time-temperature equivalence	In-house procedure
Distribution of molar mass (dynamic-mechanic)	-	P	Evaluation of the distribution of the molar mass inclusiv master curves	In-house procedure
Amplitude-dependent modulus and phase angle				
0 - 1000 %	SiS-V50, Alpha (shear)	P,C	Amplitude-dependent viscoelastic properties (T = const., f = const., sinusoidal mode)	In-house procedure
0 - 100 %	MTS 831 (shear, compression, tension)	V		
0 - 0,1 %	GABO, Metravib (tension, compression, limited amplitude range)	V	Amplitude-dependent viscoelastic properties (T = const., f = const., sinusoidal mode)	In-house procedure
Torsion Pendulum (Temperature sweep 100°C to 150°C)	Brabender torsion pendulum	V	Temperature-dependent viscoelastic properties (f \neq const., free torsional oscillation)	DIN ISO 6721

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Procedure	Denomination / Instrument Producer	For ¹	Description	Standard
Viscosity measurements: melts and compounds				In-house procedure
High-pressure capillary rheometer	Rheotester 2000 (Göttfert)	P,C	viscosity as function of shear rate	ISO 11443
log eta test	LANXESS	P	zero viscosity determined by a squeeze flow (each temperature)	In-house procedure
DMA	ARES G2 (TA), MCR (AP)	P, C	viscosity as function of shear rate (several geometries)	In-house procedure
Strain viscosity	SER II-tool	P, C	strain viscosity as function of time (each strain rate)	In-house procedure
Dielectric spectroscopy	MCR - LCR meter		Dielectric constant and loss as a function of frequency and temperature	In-house procedure
Magnetorheology	MCR - MRD		visco-elasticity as a function of magnetic field strength	In-house procedure
DMA	SIS-V50 (Scarabaeus)	P, C	viscosity as function of shear rate generated by frequency dependent tests (Cox-Merz)	In-house procedure
Viscosity measurements: solutions				
Kinematic viscosity	Ubbelohde	P, S	(kinematic) viscosity determined from gravity driven outflow behaviour (Newtonian fluids)	DIN 51562
Stabinger viscometer	SVM 3000 (AP)	S	viscosity at constant shear rate (volatile solvents)	ASTM D7042
Viscosity (brookfield test,QD)			Dissolve polymer, test solution viscosity	In-house procedure
DMA	ARES G2 (TA), MCR (AP)	S	viscosity as function of shear rate (P-P or Couette geometry)	In-house procedure
Solution viscosity (pressure cell)	pressure cell, MCR (AP)	S	viscosity as function of shear rate (Couette geometry in a pressure cell, volatile solvents)	In-house procedure

Procedure	Denomination / Instrument Producer	For ¹	Description	Standard
Solution viscosity, mastercurve (pressure cell)	pressure cell, MCR (AP)	S	as above, including construction of mastercurve by use of a suitable temperature sweep	In-house procedure
MRV (Mini Rotary Viscosimeter)	CMRV4300	S	low temperature flow behaviour of polymer additive solutions	ASTM D4684
CCS (Cold Crank Simulator)	Cannon CCS-2B	S	low temperature flow behaviour of polymer additive solutions	ASTM D5293
Further measurements of flow behaviour				
Melt flow index	Göttfert Tinius-Olsen	P,C	Flowability of polymers at defined temperature and pressure	DIN ISO 1133
Rheovulcameter	Göttfert	C	Simulation of injection molding	In-house procedure
Cold flow test	LANXESS	P	Polymer flow in orifice at 50°C	In-house procedure
Defo	Haake	P,C	Viscosity and elasticity of uncured materials	DIN 53514 (small sample)
Defo-SIS		P,C	In-house procedure	In-house procedure

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Procedure	Denomination / Instrument Producer	For ¹	Description	Standard
Density	Elatest	P, C	Density measurement by compression with a piston	In-house procedure
	Archimedes	P,C,V	Weighing of specimens in air and water	DIN 53479
Electrical Conductivity			Electrical Conductivity	
Dielectric spectroscopy	MCR - LCR meter		Dielectric constant and loss as a function of frequency and temperature	In-house procedure
Filler Dispersion	Dispergrader	C, V	Optical (magnification x100) evaluation and comparison of cut surfaces with reference pictures	ISO 11345
Microscopy		C, V	Photo by microscope	
Humidity	-	P	Mass loss during storage in exsiccator over drying agent	In-house procedure
Volatile matter	-	P	Content (mass %) of volatile ingredients in rubber sheets	Similar to DIN 53526
Moisture in granulates	Aboni Hydro Tracer	p	Moisture content, range 0.0005% - 5%	Manufacturer's instructions
Gas permeation (old)	-	V	Permeation coefficients as a function of temperature and test gas	DIN 53536
Gas permeation (automated VAC-V2)	-	V	Permeation coefficients as a function of temperature and test gas	ISO 15105
Cold bending test	-	V	Embrittlement of elastomers/bending test around a rod (-70° C to 10 °C)	In-house procedure
Fuel permeability	-	V	Amount of fuel migrating through a rubber membrane as a function of time	DIN 53532
Solubility	-	P,C	Check for undissolved particles after shaking in a suitable solvent	In-house procedure
Dirt content			Dissolve polymer, separate dirt >45µm	
Ash content			Burn in 550°C oven	ASTM D 5667
Extraction (chemicals / oil from rubber)			By Soxhlet's extractor	ASTM D 297

Procedure	Denomination / Instrument Producer	For ¹	Description	Standard
Gel content, bound rubber (centrifuge,QD)			Dissolve polymer, centrifugation, dry and weigh gel	In-house procedure
Ozone crack test, static	-	V	Crack development on the surface of strained elastomers when stored in ozonized air	DIN ISO 1431
Xenon light resistance	Heraeus	V	Treatment with light, with a spectral energy distribution similar to sunlight	DIN ISO 4892
UL94	Firetesting Technology	V	Flammability test	UL 94
Limiting Oxygen Index (LOI)	Raczek	V	Oxygenconcentration required for burning	ISO 4589
DSC	TA Instruments	P,C,V	Differential Scanning calometry	DIN 53765
TGA	TA Instruments	P,C,V	Thermogravimetric analysis	DIN 51006
ECD	DSM	V	Electo-chemical degradation	In-house procedure
Röhm Test	Evonik	V	Crack formation on PMMA surface under tension	Evonik

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Procedure	Denomination / Instrument Producer	For ¹	Description	Standard
FTIR			Fourier Transform Infrared Spectroscopy- Qualitative & Quantitative analysis	
IR			InfraRed Spetrometer Perkin Elmer	
Micro-FTIR			Fourier Transform Infrared microspectroscopy	
GPC			Gel Permeation Chromatography	
GPC with Waters 2695 Quad Detector (Wyatt - UV/LS/Viscometer/DRI)			GPC for polymer architecture such as branching	
HPLC			High-performance liquid chromatography (HPLC)	
PSA			Latex particle size or particle disperse in solvent	
Nano particle size measurement			Zetasizer Nano Series	
Particle size measurement			Mastersizer 2000 (Malvern)	
GC			Gas Chromatography	
GC-MS			Gas Chromatograph-Mass Spectrometer	
Pyrolysis GC/MS			Pyrolysis Gas Chromatograph-Mass Spectrometer	
EA			Element Analysis: C, H, N, S	
UV-Vis			Ultraviolet-visible spectrophotometry	
Hach 2100N IS Turbidimeter			Turbidity measurement	
Energy Dispersive X-ray Fluorescence Spectroscopy			Rubber Br, Cl and Ca content determination by X-ray	
TLC for rubber additive analysis				
Rubber Cl or Br content determination by titration*				
Potentiometric or PH titration			Normal Titration	
H-NMR			Determine micro-structure	
C-NMR (deponds on scan time)			Determine micro-structure	
ICP ²			Inductively Coupled Plasma-Determine trace metal element content	
EDS ²			Energy Dispersive Spectrometer-Element type analysis	
SEM ²			Scanning Electron Microscopy	

Procedure	Denomination / Instrument Producer	For ¹	Description	Standard
TEM ²			Transmission Electron Microscopy	
AFM ²			Atomic Force Microscope	
Nanoindentation ²			Atomic Force Microscope	
Microindentation Hardness Testing ²			Microindentation Hardness Testing	
Thermal Diffusivity ²			Coefficient of thermal conductivity	
SIMS ²			Secondary Ion Mass Spectrometry (SIMS)	
XPS ²			X-ray Photoelectron Spectroscopy (XPS)	
SAM ²			Scanning Auger Microscopy (SAM)	
SEM EDX Spectroscopy ²			Scanning Electron Microscopy (SEM) with Energy Dispersive X-ray (EDX) Spectroscopy	
Surface Profilometry FRT ²			Surface Profilometry	
Nanomechanical Testing ²			Nanomechanical Testing	
Laser Raman Spectroscopy ²			Laser Raman Spectroscopy	
Contact Angle Goniometry ²			Contact Angle Goniometry	
Microindentation Hardness Testing ²			Microindentation Hardness Testing	
IC ²			Ion Chromatography (IC)	
High Temperature Gel permeation chromatography (high temp-GPC) ²			High Temperature Gel permeation chromatography (high temp-GPC)	

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